de la Science et de l'Industrie is extremely satisfactory, containing much and varied information both in pure and applied science. The *Telephone Journal*, of which also No. 1 of vol. ii. lies before us, we have seen for the first time. It seems to be an organ of the Chicago branch of the Bell Telephone Company, and contains mostly a list of persons and firms telephonically connected with each other through the Central Office in Chicago. The list of names is a long one, and as the "calls" of the Company are stated to average 5,500 daily, we infer they are doing a paying business. We have already referred to the Spanish *Crónica Cientifica*; Nos. 25 and 26 are exceedingly creditable, containing a fair selection from the scientific work being done both in Spain and in other countries. Altogether science has taken a prominent and influential place in the journalism of the day.

"The Magic Lantern Manual," by Mr. W. J. Chadwick, is a plentifully illustrated little volume likely to be of great service to those, and they are many, who work with this useful apparatus in one or other of its many forms. Warne and Co. are the publishers. Equally useful in its own department is Dr. Sylvester Marsh's little manual on Section Cutting, a practical guide to the preparing and mounting of sections for the microscope, special prominence being given to the subject of animal sections. Messrs. Churchill are the publishers.

Some excavations made at Merten, near Bolchen, in German Lorraine, have given remarkable results. The remains of a gigantic equestrian statue were found, of which the figure of the rider is particularly well preserved. Investigation of other remains tend to show that the origin of the statue is Roman; parts of mosaic floors, &c., have also been discovered.

A new agricultural school is about to be established at Meissen, Saxony.

The cultivation and consumption of opium continues to increase largely in China, but notwitstanding this extended cultivation, the Persian drug is extensively consumed on account of its comparative cheapness. In a report from Amoy it is stated that the poppy is cultivated in the neighbourhood with the knowledge and sanction of the mandarins; but so far the production of opium appears in no way to affect the foreign produce, as, from the imperfect system of manufacture practised by the natives, they are unable to produce a drug in any way approaching the foreign article, either in quality or flavour. As regards the habit of using opium, Mr. Alabaster says: "It is now so general that I assume there is little probability of much increase in the demand unless the population of Formosa increase, where, as the use of opium is almost a necessity of life in the plantations there, to counteract the malarious influences of the climate there must be a larger export thither. Nor is it to be desired that the consumption should become greater, for although I cannot agree with those who so vigorously denounce the trade as a source of every evil, and am inclined to think from observation that many more lives are annually saved by its moderate use than are sacrificed to inordinate indulgence in it, an increase would now rather mark the spread of the abuse of the drug, than of its employment as a stimulant to counteract the lowering effects of climate, and damp and ill-drained houses."

The additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (*Macacus cynomolgus*) from India, presented respectively by Mr. E. E. Barclay and Mr. Eardley Holt; a Weeper Capuchin (*Cebus capucinus*) from South America, presented by Mr. W. Fridrick; two White-Fronted Capuchins (*Cebus hypoleucus*) from South America, presented by Mr. Geo. Backhouse; a Short-Tailed Wallaby (*Halmaturus brachyurus*) from West Australia, presented by Mr. G. Bowen; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. B. Baverstock; a Golden-Naped Amazon (*Chrysotis auripalliata*) from South America, presented by Mrs. H. A. Hopkins; three Canada Geese (*Bernicla canadensis*) from North America, presented by Mr. W. Bonorton; a Black-Winged Pea-fowl (*Pavo nigripennis*) from Cochin China, presented by the Hon. A. S. G. Canning, F.Z.S.; a Giraffe (*Camelopardalis giraffa*) from Nubia, deposited; a Golden-Fronted Parrakeet (*Brotogerys tuipara*), an American Tantalus (*Tantalus loculator*), a Rough Terrapin (*Clemmys punctularia*) from South America, four River Jack Vipers (*Vipera rhinoceros*) from West Africa, received in exchange.

FOREST GEOGRAPHY

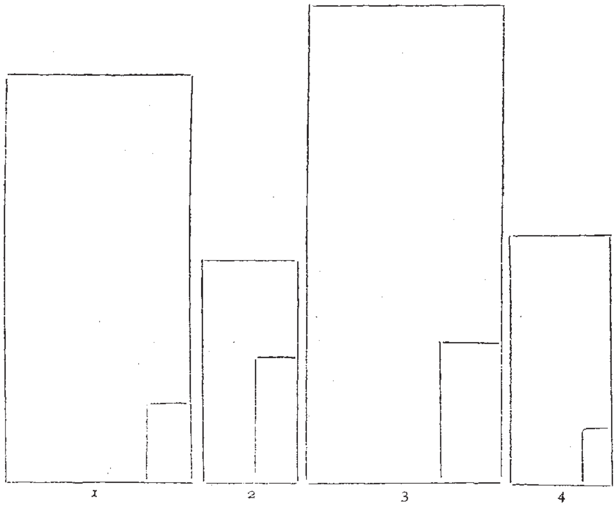
Some months ago Prof. Asa Gray delivered to the Harvard University Natural History Society a lecture on Forest Geography and Archæology, which has been published in two recent numbers of the *American Journal of Science*. The lecture referred mainly to the forests of North America, and in speaking of these, Prof. Gray referred to them not exactly as they are to-day, but as they were before civilised man had materially interfered with them. In the first part of the lecture Prof. Gray showed how the distribution of forests is mostly dependent on the distribution of moisture, and thus explained the great difference which exists in this feature between the eastern and western States. The Atlantic "forest primeval," he stated, a few generations ago covered essentially the whole country from the Gulf of St. Lawrence and Canada to Florida and Texas, and from the Atlantic to beyond the Mississippi. This Atlantic forest of the United States is one of the largest and almost the richest of the temperate forests of the world. Then going westwards from the Mississippi come prairies and open plains; beyond these is the Rocky Mountains, forest again, but only in narrow lines and patches; but after passing the Sierra Nevada, the western rim of the basin, we come to what is in some respects the noblest and most remarkable forest in the world. In the long valley of California it almost disappears again, to resume its sway in the Coast Ranges, with altered features, some of them not less magnificent and of greater beauty. Thus there are two forest-regions in North America—an Atlantic and a Pacific, each dependent on the oceans which they respectively border. Prof. Gray then goes on to show how the distribution and nature of these forests are dependent mainly on moisture and temperature, proceeding to prove that the difference in the composition of the Atlantic and Pacific forests is not less marked than that of the climate and geographical configuration to which the two are respectively adapted.

"With some very notable exceptions, the forests of the whole northern hemisphere in the temperate zone (those that we are concerned with) are mainly made up of the same or similar *kinds*. Not of the same species; for rarely do identical trees occur in any two or more widely separated regions. But all round the world in our zone, the woods contain *pines* and *firs* and *larches*, *cypresses* and *junipers*, *oaks* and *birches*, *willows* and *poplars*, *maples* and *ashes*, and the like. Yet with all these family likenesses throughout, each region has some peculiar features, some trees by which the country may at once be distinguished."

With regard to the Pacific forests the greater part of the Atlantic trees are conspicuous by their absence.

"For example, it has no magnolias, no tulip-tree, no papaw, no linden or basswood, and is very poor in maples; no locust-trees—neither flowering locust nor honey locust—nor any leguminous tree; no cherry large enough for a timber-tree, like our wild black cherry; no gum-trees (*Nyssa* nor *Liquidambar*), no sorrel-tree, nor kalmia; no persimmon, or bumelia; not a holly; only one ash that may be called a timber-tree; no catalpa, or sassafras; not a single elm, nor hackberry; not a mulberry, nor planer-tree, nor maclura; not a hickory, nor a beech, nor a true chestnut, nor a hornbeam; barely one birch tree, and that only far north, where the differences are less striking. But as to coniferous trees, the only missing type is our bald cypress, the so-called cypress of our southern swamps, and that deficiency is made up by other things. But as to ordinary trees, if you ask what takes the place in Oregon and California of all these missing kinds, which are familiar on our side of the continent, I must answer, nothing, or nearly nothing. There is the *Madroña* (arbutus) instead of our kalmia (both really trees in some places); and there is the California laurel instead of our southern red bay tree. Nor in any of the genera common to the two does the Pacific forest equal the Atlantic in species. It has not half as many maples, nor ashes, nor poplars, nor walnuts, nor birches, and those it has are of smaller size and inferior quality; it has not half as many oaks, and these and the ashes are of so inferior economical value, that (as we are told) a passable waggon-wheel cannot be made of California wood, nor a really good one in Oregon."

Prof. Gray then illustrates graphically by diagrams, which we here reproduce, this poverty of the western forest in species in type (of timber-trees); it has only 31 genera and 78 species to 66 genera and 155 species on the Atlantic side. In the appended diagrams the short side of the rectangle is proportionate to the number of genera and the long side to the number of species. The geographical areas of the two forests are not very different, the length of the Pacific forest making up to some extent for its comparative narrowness.



1. Atlantic American Forest.
2. Pacific American Forest.
3. Japan-Manchurian Forest.
4. European Forest.

"How can so meagre a forest make so imposing a show? Surely not by the greater number and size of its individuals, so far as deciduous (or more correctly non-coniferous) trees are concerned; for on the whole they are inferior to their eastern brethren in size if not in number of individuals. The reason is, that a larger proportion of the genera and species are coniferous trees; and these, being evergreen (except the larches), of aspiring port and eminently gregarious habit, usually dominate where they occur. While the east has almost three times as many genera and four times as many species of non-coniferous trees as the west, it has slightly fewer genera and almost one-half fewer species of coniferous trees than the west. That is, the Atlantic coniferous forest is represented by eleven genera and twenty-five species; the Pacific by twelve genera and forty-four species. This relative preponderance may also be expressed by the diagrams, in which the smaller inclosed rectangles, drawn on the same scale, represent the coniferous portions of these forests.

"Indeed, the Pacific forest is made up of conifers, with non-coniferous trees as occasional undergrowth or as scattered individuals, and conspicuous only in valleys or in the sparse tree-growth of plains, on which the oaks at most reproduce the features of the 'oak openings' here and there bordering the Mississippi prairie region. Perhaps the most striking contrast between the west and the east, along the latitude usually traversed, is that between the spiry evergreens which the traveller leaves when he quits California, and the familiar woods of various-hued round-headed trees which give him the feeling of home when he reaches the Mississippi. The Atlantic forest is particularly rich in these, and is not meagre in coniferous trees. All the glory of the Pacific forest is in its coniferous trees: its desperate poverty in other trees appears in the annexed diagram. These diagrams are made more instructive, and the relative richness of the forests round the world in our latitude is most simply exhibited, by adding two or three similar ones. Two will serve, one for Europe, the other for North-East Asia . . . .

"Keeping as nearly as possible to the same scale, we may count the indigenous forest trees of all Europe at 33 genera and 85 species. And those of the Japan-Manchurian region, of very much smaller geographical area, at 66 genera and 168 species. I here include in it only Japan, Eastern Manchuria, and the adjacent borders of China. The known species of trees must be rather roughly determined, but the numbers here given are not exaggerated, and are much more likely to be sensibly increased by further knowledge than are those of any of the other regions. Properly to estimate the surpassing richness of this Japan-Manchurian forest, the comparative smallness of geographical area must come in as an important consideration.

"To complete the view, let it be noted that the division of these forests into coniferous and non-coniferous is, for the

European non-coniferous,	26 genera,	68 species.
,, coniferous	7 ,,	17 ,,
	33 ,,	85 ,,
Japan-Manchurian non-coniferous	47 genera,	123 species.
,, ,, coniferous	19 ,,	45 ,,
	66 ,,	168 ,,

In other words, a narrow region in Eastern Asia contains twice as many genera and about twice as many species of indigenous trees as are possessed by all Europe; and as to coniferous trees, the former has more genera than the latter has species, and over twice and a half as many species.

"The only question about the relation of these four forest regions, as to their component species, which we can here pause to answer, is to what extent they contain trees of identical species. If we took the shrubs, there would be a small number, if the herbs a very considerable number, of species common to the two New World and to the two Old World areas respectively, at least to their northern portions, even after excluding arctic-alpine plants. The same may be said, in its degree, of the North European flora compared with the Atlantic North American, of the North-East Asiatic compared with the northern part of the Pacific North American, and also in a peculiar way (which I have formerly pointed out and shall have soon to mention) of the North-Eastern Asiatic flora in its relations to the Atlantic North American. But as to the forest trees there is very little community of species. Yet this is not absolutely wanting. The Red Cedar (*Juniperus Virginiana*) among coniferous trees, and *Populus tremuloides* among the deciduous, extend across the American continent specifically unchanged, though hardly developed as forest trees on the Pacific side. There are probably, but not certainly, one or two instances on the northern verge of these two forests. There are as many in which eastern and western species are suggestively similar. The hemlock-spruce of the Northern Atlantic States, and the yew of Florida are extremely like corresponding trees of the Pacific forest; indeed the yew-trees of all four regions may come to be regarded as forms of one polymorphous species. The white birch of Europe and that of Canada and New England are in similar case; and so is the common chestnut (in America confined to the Atlantic States), which on the other side of the world is also represented in Japan. A link in the other direction is seen in one spruce tree (called in Oregon Menzies spruce) which inhabits north-east Asia, while a peculiar form of it represents the species in the Rocky Mountains."

Prof. Gray then asks why the Pacific forest region, which is rich and in some respects unique in coniferous, should be so poor in deciduous trees. And how came California to have the monopoly of the two *Big-trees*, Sequoias, which have no near relatives anywhere? "Such relatives," he goes on to say, "as the Sequoias have are also local, peculiar, and chiefly of one species to each genus. Only one of them is American, and that solely eastern, the taxodium of our Atlantic States and the plateau of Mexico. The others are Japanese and Chinese. Why should trees of six related genera, which will all thrive in Europe, be restricted naturally, one to the eastern side of the American continent, one genus to the western side and very locally, the rest to a small portion of the eastern border of Asia? Why should coniferous trees most affect and preserve the greatest number of types in these parts of the world? And why should the north-east Asian region have, in a comparatively small area, not only most coniferous trees, but a notably larger number of trees altogether than any other part of the northern temperate zone? Why should its only and near rival be in the antipodes, namely, here in Atlantic North America? In other words why should the Pacific and the European forests be so poor in comparison, and why the Pacific poorest of all in deciduous, yet rich in coniferous trees?"

Prof. Gray ventures to conclude that this richness is normal, and that what we really have to explain is the absence of so many forms from Europe on the one hand, from Oregon and California on the other. He shows that most of the forms, even of shrubs and herbs, which are peculiar to the Atlantic forest, have their close counterparts in Japan and North China. Prof. Gray noticed the feature long ago, and evidences of the remarkable relationship have multiplied year after year.

"The result, as to the trees, is seen in these four diagrams. As to number of species generally, it cannot be said that Europe and Pacific North America are at all in arrears. But as to trees, either the contrasted regions have been exceptionally favoured, or these have been hardly dealt with. There is, as I have intimated, some reason to adopt the latter alternative.

"We may take it for granted that the indigenous plants of any country, particularly the trees, have been selected by climate. Whatever other influences or circumstances have been brought to bear upon them, or the trees have brought to bear on each other, no tree could hold its place as a member of any forest or flora which is not adapted to endure even the extremes of the climate of the region or station. But the character of the climate will not explain the remarkable paucity of the trees which compose the indigenous European forest. That is proved by experiment, sufficiently prolonged in certain cases to justify the inference. Probably there is no tree of the northern temperate zone which will not flourish in some part of Europe. Great Britain alone can grow double or treble the number of trees that the Atlantic States can. In all the latter we can grow hardly one tree of the Pacific coast. England supports all of them, and all our Atlantic trees also, and likewise the Japanese and North Siberian species, which do thrive here remarkably in some part of the Atlantic coast, especially the cooler-temperate ones. The poverty of the European sylva is attributable to the absence of our Atlantic American types, to its having no magnolia, liriodendron, asimina, negundo, no æsculus, none of that rich assemblage of leguminous trees represented by locusts, honey-locusts, gymnocladus, and cladrastis (even its cercis, which is hardly European, is like the Californian one, mainly a shrub); no nyssa, nor liquidambar; no ericaceæ rising to a tree; no bumelia, catalpa, sassafras, osage orange, hickory, or walnut; and as to conifers, no hemlock spruce, arbor-vitæ, taxodium, nor torreya. As compared with north-eastern Asia, Europe wants most of these same types, also the ailantus, gingko, and a goodly number of coniferous genera. I cannot point to any types tending to make up the deficiency, that is, to any not either in east-north America or in north-east Asia, or in both. Cedrus, the true cedar, which comes near to it, is only north African and Asian. I need not say that Europe has no sequoia, and shares no special type with California.

"Now the capital fact is, that many and perhaps almost all of these genera of trees were well represented in Europe throughout the later tertiary times. It had not only the same generic types, but in some cases even the same species, or what must pass as such, in the lack of recognisable distinctions between fossil remains and living analogues. Probably the European miocene forest was about as rich and various as is ours of the present day, and very like it. The glacial period came and passed, and these types have not survived there, nor returned. Hence the comparative poverty of the existing European sylva, or at least, the probable explanation of the absence of those kinds of trees which make the characteristic difference."

Before answering the question as to why these trees perished out of Europe but survive in America and Asia Prof. Gray inquires how these American trees came to be in Europe. From certain considerations he is led to the inference that all species closely related to each other have had a common birthplace and origin. So that when we find individuals of a species or of a group widely out of range of their fellows, we wonder how they got there. When we find the same species all round the hemisphere—and a very considerable number of species of herbs and shrubs, and a few trees are so found—we ask how this dispersion came to pass. Prof. Gray goes on to say:—

"I take it that the true explanation of the whole problem comes from a just general view, and not through piecemeal suppositions of chances. And I am clear that it is to be found by looking to the north, to the state of things at the arctic zone first, as it now is, and then as it has been. North of our forest-regions comes the zone unwooded from cold, the zone of arctic vegetation. In this, as a rule, the species are the same round the world; as exceptions, some are restricted to a part of the circle. The polar projection of the earth down to the northern tropic, as here exhibited, shows to the eye—as our maps do not—how all the lands come together into one region, and how natural it may be for the same species, under homogeneous conditions, to spread over it. When we know, moreover, that sea and land have varied greatly since these species existed, we may well believe that any ocean-gaps, now in the way of equable distribution, may have been bridged over. There is now only one considerable gap.

"What would happen if a cold period were to come on from the north, and were very slowly to carry the present arctic climate, or something like it, down far into the temperate zone? Why, just what has happened in the glacial period, when the refrigeration somehow pushed all these plants before it down to southern Europe, to middle Asia, to the middle and southern part of the United States; and at length receding, left some parts of them stranded on the Pyrenees, the Alps, the Apennines, the Caucasus, on our White and Rocky Mountains, or wherever they could escape the increasing warmth as well by ascending mountains as by receding northward at lower levels. Those that kept together at a low level, and made good their retreat, form the main body of present arctic vegetation. Those that took to the mountains had their line of retreat cut off, and hold their positions on the mountain-tops under cover of the frigid climate due to elevation. The conditions of these on different continents or different mountains are similar, but not wholly alike. Some species proved better adapted to one, some to another, part of the world; where less adapted, or less adaptable, they have perished; where better adapted, they continue—with or without some change;—and hence the diversification of alpine plants, as well as the general likeness through all the northern hemisphere.

"All this exactly applies to the temperate zone vegetation, and to the trees that we are concerned with. The clue was seized when the fossil botany of the high arctic regions came to light; when it was demonstrated that in the times next preceding the glacial period—in the latest tertiary—from Spitzbergen and Iceland, to Greenland and Kamtschatka, a climate like that we now enjoy prevailed, and forests like those of New England, and Virginia, and of California, clothed the land. We infer the climate from the trees; and the trees give sure indications of the climate.

"I had divined and published the explanation long before I knew of the fossil plants. These, since made known, render the inference sure, and give us a clear idea of just what the climate was. At the time we speak of, Greenland, Spitzbergen, and our arctic sea-shore had the climate of Pennsylvania and Virginia now. It would take too much time to enumerate the sorts of trees that have been identified by their leaves and fruits in the arctic later tertiary deposits.

". . . . Long genealogies always deal more or less in conjecture; but we appear to be within the limits of scientific inference when we announce that our existing temperate trees came from the north, and within the bounds of high probability when we claim not a few of them as the originals of present species. Remains of the same plants have been found fossil in our temperate region, as well as in Europe.

"Here, then, we have reached a fair answer to the question how the same or similar species of our trees came to be so dispersed over such widely separated continents."

Prof. Gray then shows what would naturally follow from a gradual pushing of the Arctic vegetation southwards, and that the modifications resulting from differences of climate in the divergent continents, and on their different sides, might well account for the present diversification. The siftings and resiftings which have since taken place from changes of climate, submergence, and re-emergence, and other causes, have left their impress on the actual vegetation, especially on the trees. They furnish probable reason for the loss of American types sustained by Europe.

"I conceive that three things have conspired to this loss. First, Europe, hardly extending south of latitude 40°, is all within the limits generally assigned to severe glacial action.

Second, its mountains trend east and west, from the Pyrenees to the Carpathians and the Caucasus beyond, near its southern border; and they had glaciers of their own, which must have begun their operations, and poured down the northward flanks, while the plains were still covered with forest on the retreat from the great ice-wave coming from the north. Attacked both on front and rear, much of the forest must have perished then and there. Third, across the line of retreat of those which may have flanked the mountain-ranges, or were stationed south of them, stretched the Mediterranean, an impassable barrier. Some hardy trees may have eked out their existence on the northern shore of the Mediterranean and the Atlantic coast. But we doubt not, taxodium and sequoias, magnolias and liquidambars, and even hickories and the like were among the missing. Escape by the east, and rehabilitation from that quarter until a very late period, was apparently prevented by the prolongation of the Mediterranean to the Caspian, and thence to the Siberian ocean."

Prof. Gray shows that on the American continent on the other hand the trees, when touched in the north by the incoming refrigeration, had only to move their southern border southward, along an open way, as far as the exigency required; and there was no impediment to their due return. The still greater richness of north-east Asia in arboreal vegetation may find an explanation in the prevalence of particularly favourable conditions, both anteglacial and recent.

"The case of the Pacific forest is remarkable and paradoxical. It is, as we know, the sole refuge of the most characteristic and wide-spread type of miocene coniferæ, the sequoias; it is rich in coniferous types beyond any country except Japan; in its gold-bearing gravels are indications that it possessed, seemingly down to the very beginning of the glacial period, magnolias and beeches, a true chestnut, liquidambar, elms, and other trees now wholly wanting to that side of the continent, though common both to Japan and to Atlantic North America. Any attempted explanation of this extreme paucity of the usually major constituents of forest, along with a great development of the minor, or coniferous, element, would take us quite too far, and would bring us to mere conjectures."

Prof. Gray concludes his interesting lecture by saying :—

"I have done all that I could hope to do in one lecture if I have distinctly shown that the races of trees, like the races of men, have come down to us through a prehistoric (or prenatural-historic) period; and that the explanation of the present condition is to be sought in the past, and traced in vestiges, and remains, and survivals; that for the vegetable kingdom also there is a veritable archæology."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Cambridge Smith's Prizes have been awarded to Micaiah John Muller Hill, B.A., St. Peter's College, and Arnold Joseph Wallis, B.A., Trinity College, bracketed equal. These gentlemen were also bracketed equal as fourth wranglers in 1879.

A UNIVERSITY for ladies will be opened shortly in Odessa. It will have three faculties—History and Literature, Mathematics, and Natural Science. The programme will be the same as in the other Russian Universities for male students, with a few changes. Greek will not be obligatory in the Historico-Literary Faculty; there will be in the same faculty a Chair of Political Economy and Statistics. Pedagogy and hygiene will be obligatory in all faculties.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 12, 1878.—In an inaugural dissertation here given, Herr Nahrwold studies atmospheric electricity; his method of experiment having been to electrify air in a cylindrical vessel fitted with a (mercury) dropping collector. His first attempts, with points, convinced him that only the dust, not the air, could be thus electrified; he then successfully used a fine platinum wire kept glowing with a battery (the air having been first freed from dust), and a condenser or galvanic element connected with the circuit. Interesting data are furnished with regard to the charge of the air, the ratio of this to the source of electricity used, and the decrease of the charge. Some of the observations seem to throw doubt on Thomson's conclusions as to the distribution of electricity in the upper regions of the atmosphere.—Herr Wiedemann offers a theory on the nature of spectra, deduced from the kinetic theory of gases. Line-spectra are attributed to oscillatory motions of atoms, isolated at high temperatures; band spectra of elements and spectra of compounds to vibrations of atoms in the molecule, or of the ether-envelopes.—A quantitative verification of the electrodynamic law, regarding the reciprocal action of closed circuits, for the case in which the circuit suffers deformation, is furnished by Herr Niemöller.—Herr Korteweg discusses the velocity of propagation of sound in elastic tubes, and Herr Rühlmann gives formulæ for measurement of ocean depths with the manometer.—There are several notes on crystallography.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 23.—"Researches on Lactin," by Edmund J. Mills, D.Sc., F.R.S., "Young" Professor of Technical Chemistry in Anderson's College, Glasgow, and James Hogarth.

The authors have investigated lactin with the aid of polarised light, their object being to gain further insight into the chemical nature of that compound. Their conclusions are as follows :—

1. The initial specific rotation of lactin is 92°·63.
2. The permanent specific rotation of lactin is 59°·17.
3. The change of rotation of a solution of lactin can be expressed by a mathematical equation.
4. When the specific rotation 64°·8 is reached, the law of change must be expressed by a different equation.
5. The initial solubility of lactin is one part lactin in 10·64 parts water.
6. The permanent solubility is one part lactin in 3·23 parts water.

"Researches on Chemical Equivalence." Part II. Hydric Chloride and Sulphate. By Edmund J. Mills, D.Sc., F.R.S., and James Hogarth.

While carrying out their researches on lactin, it struck the authors that use might be made of it to compare the dynamical equivalents of acid bodies. They accordingly selected hydric chloride and hydric sulphate for the measurements in question.

The results show that though $2HCl$ may be the "equivalent" of H_2SO_4 in weight for saturation (*i.e.*, in the ordinary sense), it certainly is not the equivalent in the dynamical sense. They also render it highly probable that HCl is equal dynamically to H_2SO_4. Ostwald, by a method based on the alteration of the specific volume of solutions, has shown that the ratio $\frac{2HCl}{H_2SO_4} = 1·93$, a result which their numbers, though not as perfect as the authors could wish, nevertheless strongly confirm.

"Limestone as an Index of Geological Time," by T. Mellard Reade, C.E.

January 30.—"On Certain Means of Measuring and Regulating Electric Currents." By C. William Siemens, D.C.L., F.R.S.

The dynamo-electro machine furnishes us with a means of producing electric currents of great magnitude, and it has become a matter of importance to measure and regulate the proportionate amount of current that shall be permitted to flow through any branch circuit, especially in such applications as the distribution of light and mechanical force.

On June 19 last, upon the occasion of the *soirée* of the President of the Royal Society, was exhibited a first conception of an arrangement for regulating such currents, which the author has since worked out into a practical form. At the same time a method has been realised by which currents passing through a circuit, or branch circuit, are measured, and graphically recorded.

It is well known that when an electric current passes through a conductor heat is generated, which, according to Joule, is proportionate in amount to the resistance of the conductor, and to the square of the current which passes through it in a unit of time, and advantage has been taken of this well-established law of electro-dynamics, in order to limit and determine the amount of current passing through a circuit.

The paper refers to three instruments, in the first of which one end of a thin strip of metal is attached to a screw, by which its tension can be regulated; it then passes upwards over an elevated insulated pulley, and down again to the end of a short